Transmission power control with dynamic step values

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Abstract

Transmission power control with dynamic step value depending on a location of a mobile terminal in a radio zone is realized. The mobile terminal detects its location, whether close to a radio base station, a boundary of the radio zone, or an intermediate location, by an intensity of reception field strength of a radio signal transmitted by a radio base station. The radio base station, which has received and measured the radio signal quality transmitted by the mobile terminal, instructs the transmission power control information (increasing or decreasing) to the mobile terminal in accordance with the measured radio signal quality. When "decreasing" instructions are received repeatedly at the mobile terminal when the mobile terminal is located near the radio base station, a larger step value than a normal case is used for decreasing transmission power of the mobile terminal. When "increasing" instructions are received repeatedly at the mobile terminal when the mobile terminal is located in the boundary of the radio zone, a larger step value than the normal case is used for increasing transmission power of the mobile terminal.

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a transmission power control system of a mobile terminal in a mobile communication network and a method of transmission power control thereof. More particularly, the present invention concerns a transmission power control in which a quality of a radio signal transmitted from a mobile terminal under communication is measured in a radio base station and the measured result is reported to a radio base station control apparatus, and then in response to the measured quality of the radio signal, the radio base station control apparatus instructs the mobile terminal through the radio base station to change (increase or decrease) the transmission power thereof.

2. Description of the Related Art

In general, a mobile communication system is arranged by a plurality of radio base stations for constituting a plurality of radio zones, and a radio base station control apparatus, which entirely controls these plural radio base stations, connected to a mobile communication switching station interfaced with a fixed communication network. FIG. 8 is a flow chart for indicating one example of the conventional transmission power control method for the mobile terminal in such a mobile communication system. The radio base station control apparatus transfers the power control information to the radio base station in response to the radio signal quality of the mobile terminal measured by the radio base station, and the radio base station informs the power control information to the mobile terminal by using the down-stream signal channel. As indicated in FIG. 8, the power control information includes a power control bit to indicate change of power to be transmitted from the mobile terminal. When the power control bit=1, it indicates that the transmission output is to be increased by one step of value which has been predetermined, and, to the contrary, when the power control bit =0, it indicates that the transmission output is to be decreased by one step of value which has also been predetermined. In response to the respective instructions, the mobile terminal increases or decreases the transmission power with a predetermined changing width by 1 step.

Other than such a control method, there is a further method for autonomously controlling the transmission power based upon the reception field strength of the radio signal transmitted from the radio base station and received by this mobile terminal (see Japanese Laid-open Patent Application No. shou 61-43026). Also, in the method of instructing a change in the transmission power from the radio base station control apparatus, number of steps to be changed for increasing, or decreasing the transmission power is instructed.

In the above-described conventional transmission power control method for the mobile terminal, when the mobile terminal autonomously controls the transmission power, this power control is carried out based on the reception field strength at the mobile terminal. As a consequence, this power control will accept a temporal level down in the reception field strength due to such as the fading phenomenon. Therefore, the mobile terminal does not always output the optimum transmission power.

In another case that the transmission power is controlled in response to the instruction issued from the radio base station control apparatus, it will take a lengthy time period until the transmission power output value reaches the optimum value. There is such a problem that since the mobile terminal whose power supply has been just turned ON firstly transmits the radio signal in the maximum transmission power, waste power consumption occurs until this maximum transmission power reaches the optimum transmission power. There is another problem that when the radio signal is transmitted in high power by this mobile terminal, other mobile terminals will receive interference. Therefore, it is required to quickly control the transmission power to become the optimum transmission power within a short time.

SUMMARY OF THE INVENTION

Therefore, a transmission power control system and method for a mobile terminal, according to the present invention, has been made to solve the above-described problems, and has an object such that a time period required when transmission power of the mobile terminal reaches an optimum value is shortened, whereby unnecessary power consumption can be suppressed, and interference adversely given to other mobile terminals can be reduced as much as possible.

In a transmission power control system for a mobile terminal, according to the present invention, the transmission power control system for a mobile terminal is arranged by a plurality of mobile terminals, at least one radio base station, and a radio base station control apparatus which judges a reception field strength of a radio signal received from the mobile terminal and then instructs this mobile terminal to increase or decrease an output value of transmission power thereof. The mobile terminal is featured by comprising the below-mentioned arrangements:
(1) reception field strength measuring means which measures an intensity of reception field strength of a radio signal being communicating with the radio base station in the radio zone thereof;
(2) control means which discriminates an area in a radio zone, where the mobile station being located, by the intensity of reception field strength of measuring result of the reception field strength measuring means, determines a step value to be used for changing transmission power of the mobile terminal depending on discriminated area in the radio zone,

detects contents of said instruction provided by the radio base station control apparatus, and outputs transmission power control information, to increase transmission power by the step of value having been determined by the location of the mobile terminal in the radio zone when contents of the instraction being indicating power increase, and to decrease transmission power by the step of value having been determined by the location of the mobile terminal in the radio zone when contents of the instruction being indicating power decrease; and
(3) transmission power control means which controls output of transmission power in accordance with an output of the control means.

The control means of the mobile terminal further includes first sub control means which stores a plurality of measuring results of the intensity of reception field strength of the radio signal of the radio base station, comparing with the latest measuring result and past measuring results, being stored, of the intensity of reception field strength of the radio signal of the radio base station, and adds predetermined step value to the determined step value to be used for changing transmission power of the mobile terminal when an intensity difference of comparing result exceeds predetermined threshold value.

Second sub control means in the control means is also a part of the present invention, which counts up number of continued same indication, whether increasing or decreasing, and adds predetermined step value to the determined step value to be used for changing transmission power of the mobile terminal when the counted number reach a predetermined threshold value.

As for a method of transmission power control of the present invention, it comprises the following steps of:
(1) discriminating an area in a radio zone, where the mobile station being located, by measuring an intensity of reception field strength of a radio signal being communicating with the radio base station in the radio zone thereof;
(2) determining a step value to be used for changing transmission power of the mobile terminal depending on discriminated area in the radio zone;
(3) detecting contents of the instruction provided by the radio base station control apparatus;
(4) increasing transmission power by the step of value having been determined by the location of the mobile terminal in the radio zone when contents of the instruction being indicating power increase; and
(5) decreasing transmission power by the step of value having been determined by the location of the mobile terminal in the radio zone when contents of the instruction being indicating power decrease.

The following steps are also a method of the present invention:
(1) measuring an intensity of reception field strength of a radio signal, at the mobile station, being communicating with the radio base station in the radio zone thereof;
(2) storing a plurality of measuring results of the intensity of reception field strength of the radio signal of the radio base station;
(3) discriminating an area in a radio zone, where the mobile station being located, by the latest measuring result of the intensity of reception field strength of the radio signal of the radio base station;
(4) determining a step value to be used for changing transmission power of the mobile terminal depending on discriminated area in the radio zone;
(5) comparing with the latest measuring result and past measuring results, being stored, of the intensity of reception field strength of the radio signal of the radio base station, and adding predetermined step value to the determined step value to be used for changing transmission power of the mobile terminal when an intensity difference of comparing result exceeds predetermined threshold value;
(6) detecting contents of the instruction provided by the radio base station control apparatus;
(7) increasing transmission power by the step of value having been determined as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal when contents of the instruction being indicating power increase; and
(8) decreasing transmission power by the step of value having been determined as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal when contents of the instruction being indicating power decrease.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference is made of a detail description to be read in conjunction with the accompanying drawings, in which:

FIG. 1 schematically represents a structural diagram of a mobile communication system to which a transmission power control system and method for a mobile terminal, according to the present invention, is applied;

FIG. 2 is a schematic block diagram for indicating an arrangement of a mobile terminal to which the transmission power control system for a mobile terminal according to the present invention is applied;

FIG. 3 schematically indicates a signal structural diagram of a burst signal transmitted from a radio base station control apparatus to a mobile terminal;

FIG. 4 is a conceptional diagram for representing a radio zone constituted by a radio base station;

FIG. 5 is a flow chart for explaining operations of the transmission power control method according to a first

embodiment of the present invention;

FIG. 6 is a flow chart for explaining operations of the transmission power control method according to a second embodiment of the present invention;

FIG. 7 is a signal sequence diagram for explaining operations of the transmission power control method according to a third embodiment of the present invention; and

FIG. 8 is a flow chart for describing the operations of the conventional transmission power control method for the mobile terminal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to drawings, a transmission power control system according to the present invention will be described.

FIG. 1 is a system arrangement diagram for schematically showing a mobile terminal (portable radio terminal), a radio base station, and a radio base station control apparatus, employed in a transmission power control system and method for a mobile terminal according to the present invention.

That is, the mobile terminal 100 owns a function to transmit and/or receive radio signals having frequencies f1 and f1' with respect to the radio base station 101 in a radio zone L1. Also, the mobile terminal 100 owns another function to measure a reception field strength as to the reception frequency of f1, and a further function to store this measurement value.

The radio base stations 101 and 102 are connected to the radio base station control apparatus 103, and each radio base station owns such a function that data transmission/reception between the radio base station control apparatus 103 and mobile terminals within the constructed radio zone L1 or L2 respectively are repeated by using the allocated radio frequencies. The radio base station 101 has a function to measure a reception field strength as to the reception frequency f1' in order to monitor a quality of a radio signal, and to notify the measurement value to the radio base station control apparatus 103.

The radio base station control apparatus 103 transmits and receives data between the radio base stations 101, 102 connected to this control apparatus 103, and a mobile terminal which is connected to these radio base stations in the wireless manner. This radio base station control apparatus 103 owns a function to monitor the reception field strength of the mobile terminal 100 under communication, and another function to send an instruction to the mobile terminal 100 to increase/decrease the transmission power thereof in response to the measured reception field strength.

FIG. 2 is a block diagram for showing an internal arrangement of a mobile terminal employed in the transmission power control system according to a first preferred embodiment of the present invention.

In FIG. 2, a radio signal transmitting/receiving unit 201 is radio-interfaced with the radio base station, and both a receiving unit 202 and a demodulating unit 203 convert a radio reception signal into a digital signal. A CODEC unit 204 performs coding/decoding operations of a speech (voice) signal, and both a transmitting unit 205 and a modulating unit 206 convert a digital signal into a radio transmission signal. A reception field strength measuring unit 207 measures a reception field strength of the radio signal received by the radio transmitting/receiving unit 201. A transmission power control unit 208 controls transmission power in response to an instruction issued from a control unit 209. The control unit 209 connects communication channels involving a radio section, and controls the respective functional blocks. The control unit 209 also has a function to determine an increasing width and a decreasing width of the transmission power based upon the reception field strength, another function to store the measured reception field strength, and another function to instruct the transmission power control unit 208 to increase, or decrease the transmission power.

FIG. 3 schematically indicates a structural diagram of a burst signal of a down-stream link, which is transmitted by a radio base station to a mobile terminal. The radio base station control apparatus controls the transmission power of the mobile terminal based on a power control bit set in this burst signal. In this embodiment, the power control bit="1" instructs the mobile terminal to increase the transmission power thereof, whereas the power control bit="0" instructs the mobile terminal to decrease the transmission power thereof.

FIG. 4 is a conceptional diagram for representing one example of a radio zone, which is divided into some area blocks depending on an intensity of radio field radiated by the radio base station.

In FIG. 4, a block 401 is an area with a high reception field strength, namely, the area located near a center of this radio zone. A block 402 is an area with a low reception field strength, namely the area located near a boundary of the radio zone. A block 403 is an intermediate block between the block 401 and the block 402. The respective area blocks are discriminated from each other based on the reception field strengths measured by the mobile terminal existing in the radio zone thereof. To this end, the mobile terminal owns a first area block discriminating threshold value so as to discriminate the block 401 from the block 403, and a second area block discriminating threshold value in order to discriminate the block 402 from the block 403.

Next, operations of the present invention will now be explained with reference to FIG. 5. FIG. 5 is a flow chart for

describing operations of the transmission power control for the mobile terminal according to the first embodiment of the present invention.

It should be noted that in the mobile terminal of FIG. 2, the first area block discriminating threshold value and the second area block discriminating threshold value have been previously set to the control unit 209 so as to discriminate the area blocks from each other, as explained with reference to FIG. 4.

Also, the control unit 209 stores the proper number of reception field strength values having been measured in each time of measurement, and has a function to calculate an average value of these reception field strength values being stored, and further stores a threshold value for reception field strength variation in order to check a changing degree of a reception field strength.

Also, the transmission power control unit 208 is capable of controlling the transmission power under such a condition that a range of 30 dBm is controllable by 0.5 dBm per one step.

In the mobile terminal, the reception field strength of the frequency f1 sent from the radio base station 101 is measured by the reception field strength measuring unit 207, and the measurement result is notified to the control unit 209.

The control unit 209 calculates an average value of reception field strength based upon the notified reception field strength and the proper number of predetermined reception field strengths. Then, the control unit 209 compares this average reception field strength with the first area block discriminating threshold value and the second area block discriminating threshold value in order to judge where the own terminal is located in any one of the area blocks.

The following discrimination is made: When the average value of reception field strength is larger than the first area block discriminating threshold value 1, the mobile terminal is present in the area block 401. When the average reception field strength is smaller than the second area block discriminating threshold value 2, the mobile terminal is present in the area block 402. When the average value of reception field strength exists between the first area block discriminating threshold value and the second area block discriminating threshold value, the mobile terminal is present in the block 403 (step 500).

Then, the increasing width and the decreasing width of the transmission power are determined based on the discrimination result (step 501). For instance, in the case where the mobile terminal is present in the block 401, the unit of the above-described increasing width and decreasing width is set to 3 steps and 1 step, respectively. In the case of block 402, the unit of the above-described increasing width and deceasing width is set to 1 step and 3 steps respectively. In the case of block 403, the unit of the increasing width and decreasing width is set to 1 step and 1 step respectively.

Next, the measured reception field strength is compared with the previous reception field strength which has been measured and stored (step 502).

In such a case that the difference value (comparison result) is larger than the threshold value of reception field strength difference, when the reception field strength is increased, 1 step is added to the increasing width of the transmission power, whereas when the reception field strength is decreased, 1 step is added to the decreasing width of the transmission power (step 503).

The control unit 209 determines the increasing width and the decreasing width of the transmission power, and thereafter acquires the power control bit set in the burst signal received from the radio base station 101. Then, the control unit 209 checks the value set in this power control bit (step 504).

When "1" is set in the power control bit, the control unit 209 instructs the transmission power control unit 208 to increase the transmission power and notifies the increasing width of the transmission power (step 505). When "0" is set in the power control bit, the control unit 209 instructs the transmission power control unit 208 to decrease the transmission power and notifies the decreasing width of the transmission power (step 506).

Then, the transmission power control unit 208 increases or decreases the transmission power in accordance with the instruction about the transmission power, and also the increasing width, or decreasing width of the transmission power, which are received from the control unit 209.

It should be understood that the step numbers used to control the transmission powers at the steps 501 and 502 may be properly selected in the present invention. Also, properly selected number of average reception field strength may be employed instead of the previous reception field strength used at the steps 502 and 503. Also, the decreasing width of the transmission power need not be added which is determined by the changing degree of the reception field strength at the step 503.

Subsequently, a transmission power control method for mobile terminals according to a second embodiment of the present invention will now be explained with reference to FIG. 6. FIG. 6 is a flow chart for describing operations of the transmission power control for a mobile terminal according to the second embodiment of the present invention.

In the mobile terminal, the control unit 209 owns a function to store the properly selected number of setting values of

the power control bit preset to each of the burst signals in addition to the above-explained function of the first embodiment.

Similar to the operations described in the flow chart of FIG. 5, the control unit 209 determines the increasing width and the decreasing width of the transmission power (steps 600 to 603), and thereafter acquires the power control bit contained in the received burst signal to check the value set in this power control bit (step 604).

When "1" is set to this power control bit, the properly selected number of power control bits which have been previously stored are checked. When "1" is continuously received by a predetermined number of times, e.g., 10 times (step 605), 2 steps are added to the increased width of the transmission power (step 606). The control unit 209 determines the increasing width of the transmission power, and thereafter instructs the transmission power control unit 208 to increase the transmission power and also notifies the increasing width of the transmission power (step 607).

When "0" is set at the step 604, the properly selected number of power control bits previously stored are checked. If "0" is continuously received 10 times (step 608), then 2 steps are added to the decreasing width of the transmission power (step 609). The control unit 209 determines the decreasing width of the transmission power, and thereafter instructs the transmission power control unit 208 to decrease the transmission power and notifies the decreasing width of the transmission power.

In response to the instruction about the transmission power and also the increasing width, or the decreasing width of the transmission power received from the control unit 209, the transmission power control unit 208 increases, or decreases the transmission power.

As to such a transmission power control method of the mobile terminal, a concrete embodiment will be explained. The following description is made of such a case that the mobile terminal 100 is located near a center of the radio zone when the power supply is turned ON. It is assumed that in the mobile terminal 100, the transmission power is controllable within a range of 30 dBm by 0.5 dBm per one step, and further this mobile terminal 100 is not moved from the center area of the radio zone after the power supply is turned ON.

The mobile terminal 100 is communicated with the radio base station by setting the transmission power to the maximum power when the power supply is turned ON. On the other hand, the optimum transmission power in the area near the center of the radio zone is equal to the minimum power. That is, in this case, the transmission power of the mobile terminal 100 must be varied from the maximum power to the minimum power. While the maximum power is changed into the minimum power, the power control bit set to the burst signal received from the radio base station is continuously set to "0" until the transmission power of the mobile terminal 100 becomes the optimum transmission power, namely the minimum transmission power. Since the mobile terminal 100 is not moved from the area near the center of the radio zone, there is no variation in the reception field strength.

The mobile terminal 100 judges that the own mobile terminal is located in the block 401 based on the reception field strength measured when the power supply is turned ON, and then determines the 3 steps as the decreasing width of the transmission power (steps 600 and 601). Since there is no change in the reception field strength, no addition of the decreasing width of the transmission power is carried out (step 604). Since the continuous reception times of the power control bit="0" do not reach a preselected time (10 times), the mobile terminal 100 decreases the transmission power by setting the decreasing width of the transmission power to the 3 steps (step 608).

Since there is no variation in the reception field strength because of no movement of the mobile terminal from the original position, the mobile terminal 100 decreases the transmission power by setting the decreasing width of the transmission power to the 3 steps until the number of received burst signals reach 10. When the number of received burst signals reach 10, the 2 steps are added to the decreasing width of the transmission power (steps 608 and 609), and the transmission power is decreased by setting the decreasing width of the transmission power to the 5 steps.

In this second embodiment, a total number of received burst signals until the maximum transmission power of the mobile terminal 100 is changed into the minimum transmission power thereof, namely the transmission power is changed by 30 dBm, is equal to 16 bursts. That is, there are 10 bursts until the transmission power is first reduced to 15 dBm, and there are 6 bursts until the transmission power is reduced to the remaining 15 dBm.

Assuming now that the mobile terminal using conventional power control method decreases the transmission power one step by one step, 60 burst signals should be received until the transmission power is changed to 30 dBm. In comparison with the above-described mobile terminal using conventional power control method, the time period required to reach the optimum transmission power in the mobile terminal using the present invention can become 3.75 times higher than that of the mobile terminal using conventional power control method, namely higher efficiency.

Furthermore, a description will now be made of a transmission power control method for a mobile terminal according to a third embodiment of the present invention. FIG. 7 is a communication sequence diagram for describing such a case that the radio base station control apparatus notifies the respective setting values used to control the transmission power of the mobile terminal.

In this mobile terminal 100, the following values are stored in the control unit 209 as an initial setting value for previously controlling the transmission power, and then the transmission power is controlled in accordance with this

setting value. That is, these values are the number of values of reception field strength to be stored, the first area block discriminating threshold value, the second area block discriminating threshold value, the increasing width/decreasing width of the transmission powers for the respective area blocks, the threshold value of the reception field strength variation, and the number of times and the continuous received number of times of power control bits to be stored.

The radio base station control apparatus 103 notifies the respective setting values as notification information 601 via the radio base stations 101 or 102 to the mobile terminal 100 under communication. When the mobile terminal 100 receives the notification information 601, the control unit 209 stores the respective setting values related to the transmission power control set in this notification information 601, and thereafter carries out the transmission power control in response to this setting value. The radio base station control apparatus 103 continuously notifies the same setting values as the notification information unless there is a change.

According to the present invention, the respective setting values are not limited to the above-explained setting values, which are notified as the notification information 601 used to control the transmission power, but only necessary setting values may be notified.

In accordance with the transmission power control system and method for a mobile terminal of the present invention, it is possible to shorten the time period required to set the transmission power of the mobile terminal to the optimum transmission power. This is because the increasing/decreasing widths of the transmission power are changed in response to the reception field strength and also the changing degree in the reception field strength of the transmission signal received by the own mobile terminal.

Since the time period required up to the optimum transmission power can be reduced, when the transmission power is higher than the optimum transmission power, the time period during which extra power is consumed can be shortened. This may reduce the adverse influences caused by the interference with respect to other mobile terminals. On the other hand, when the transmission power is lower than the optimum transmission power, there is a merit that the communication condition of the own mobile terminal can be quickly kept under better condition.

Although the present invention has been fully described by way of the preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications will be apparent to those having skill in this field. Therefore, unless these changes and modifications otherwise depart from the scope of the present invention, they should be construed as included therein.

Claims

What is claimed is:

1. A transmission power control system for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said transmission power control system for said mobile terminal comprising:
a reception field strength measuring unit configured to measure an intensity of reception field strength of a radio signal being used to communicate with said radio base station in a radio zone thereof;
a control unit communicatively coupled to said reception field strength measuring unit and configured to discriminate an area in said radio zone where said mobile terminal is located from a plurality of candidate areas that make up said radio zone, each candidate area being defined by a corresponding range of distances from said radio base station, the discriminating being made based on the intensity of reception field strength as measured by said reception field strength measuring unit, said control unit configured to determine a step value to be used for changing transmission power of said mobile terminal depending on the discriminated area in said radio zone, said control unit configured to detect contents of said instruction provided by said radio base station control apparatus, and said control unit configured to output transmission power control information, to increase the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instructions indicate a power increase, and to decrease the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instruction indicate a power decrease; and
a transmission power control unit communicatively coupled to said control unit and configured to control output of transmission power in accordance with an output of said control unit.

2. The transmission power control system for a mobile terminal according to claim 1, said control unit further comprising:
a first sub control unit configured to count up a number of sequentially same indications, whether increasing or decreasing, and configured to add a predetermined step value to the determined step value to be used for changing the transmission power of said mobile terminal when the counted number reaches a first predetermined threshold value.

3. The transmission power control system for a mobile terminal according to claim 1, wherein said plurality of candidate areas include a first candidate area which corresponds to a center of said radio zone, a second candidate area which corresponds to an outer boundary of said radio zone, and a third candidate area which is located between said first and second candidate areas.

4. A transmission power control system for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, said reception field strength having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said transmission power control system for said mobile terminal comprising:
a reception field strength measuring unit configured to measure an intensity of the reception field strength of a radio signal being used to communicate with said radio base station in a radio zone thereof;
a control unit communicatively coupled to said reception field strength measuring unit and configured to discriminate an area in said radio zone where said mobile terminal is located, the discriminating being made based on the intensity of reception field strength as measured by said reception field strength measuring unit, said control unit configured to determine a step value to be used for changing transmission power of said mobile terminal depending on the discriminated area in said radio zone, said control unit configured to detect contents of said instruction provided by said radio base station control apparatus, and said control unit configured to output transmission power control information, to increase the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instructions indicate a power increase, and to decrease the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instruction indicate a power decrease; and
a transmission power control unit communicatively coupled to said control unit and configured to control output of transmission power in accordance with an output of said control unit,
said control unit further comprising:
a first sub control unit configured to store a plurality of measuring results of the intensity of reception field strength of the radio signal of said radio base station, said first sub control unit configured to compare with a latest measuring result and past measuring results, being stored, of the intensity of reception field strength of the radio signal of said radio base station, and said first sub control unit configured to add a predetermined step value to the determined step value to be used for changing transmission power of said mobile terminal when an intensity difference of the comparing result exceeds a first predetermined threshold value.

5. The transmission power control system for a mobile terminal according to claim 4, said control unit further comprising:
a first sub control unit configured to count up a number of sequentially same indications, whether increasing or

decreasing, and configured to add the predetermined step value to the determined step value to be used for changing the transmission power of said mobile terminal when the counted number reaches the first predetermined threshold value.

6. A method of transmission power control system for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said method comprising:
discriminating an area in a radio zone where said mobile terminal is located from a plurality of candidate areas that make up said radio zone, each candidate area being defined by a corresponding range of distances from said radio base station, by measuring an intensity of reception field strength of a radio signal, at said mobile terminal, being used to communicate with said radio base station in said radio zone thereof;
determining a step value to be used for changing a transmission power of said mobile terminal depending on the discriminated area in said radio zone;
detecting contents of said instruction provided by said radio base station control apparatus;
increasing the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instruction indicate a power increase; and
decreasing the transmission power by the step value having been determined by the discriminated area of said mobile terminal in said radio zone when the detected contents of said instruction indicate a power decrease.

7. The method according to claim 6, wherein said plurality of candidate areas include a first candidate area which corresponds to a center of said radio zone, a second candidate area which corresponds to an outer boundary of said radio zone, and a third candidate area which is located between said first and second candidate areas.

8. A method of transmission power control for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said method comprising:
measuring an intensity of reception field strength of a radio signal, at said mobile terminal, being used to communicate with said radio base station in said radio zone thereof;
storing a plurality of measuring results of the intensity of reception field strength of the radio signal of said radio base station;
discriminating an area in a radio zone, where said mobile terminal is located, by the latest measuring result of the intensity of reception field strength of the radio signal of said radio base station;
determining a step value to be used for changing a transmission power of said mobile terminal depending on the discriminated area in said radio zone;
comparing with the latest measuring result and past measuring results, being stored, of the intensity of reception field strength of the radio signal of said radio base station, and adding a fixed step value to the determined step value to be used for changing the transmission power of said mobile terminal when an intensity distribution of the comparing result exceeds a fixed threshold value;
detecting contents of said instruction provided by said radio base station control apparatus;
increasing the transmission power by the step value having been determined as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal when the detected contents of said instruction indicate a power increase; and
decreasing the transmission power by the step value having been determined as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal when the detected contents of said instruction indicate a power decrease.

9. A method of transmission power control for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said method comprising:
discriminating an area in a radio zone where said mobile terminal is located from a plurality of candidate areas that make up said radio zone, each candidate area being defined by a corresponding range of distances from said radio base station the discriminating being made by measuring an intensity of reception field strength of a radio signal, at said mobile terminal, being used to communicate with said radio base station in said radio zone thereof;
determining a step value to be used for changing a transmission power of said mobile terminal depending on the discriminated area in said radio zone;
detecting contents, whether indicating increase or decrease, of said instruction provided by said radio base station control apparatus;
counting up a number of sequentially same indications, and adding a fixed step value to the determined step value to be used for changing transmission power of said mobile terminal when the counted number reaches a fixed threshold value;
increasing the transmission power by the step value having been determined as the result of counting up the number of sequentially same indications when the detected contents of said instruction indicate a power increase; and
decreasing the transmission power by the step value having been determined as the result of counting up the number of sequentially same indications when the detected contents of said instruction indicate a power decrease.

10. The method according to claim 9, wherein said plurality of candidate areas include a first candidate area which

corresponds to a center of said radio zone, a second candidate area which corresponds to an outer boundary of said radio zone, and a third candidate area which is located between said first and second candidate areas.

11. A method of transmission power control for a mobile terminal in a mobile communication network, comprising at least one radio base station coupled with a radio base station control apparatus judging an intensity of reception field strength of a radio signal of said mobile terminal, having been measured and reported from said radio base station, and providing an instruction of transmission power control to said mobile terminal, said method comprising:
measuring an intensity of reception field strength of a radio signal, at said mobile terminal, being used to communicate with said radio base station in said radio zone thereof;
storing a plurality of measuring results of the intensity of reception field strength of the radio signal of said radio base station;
discriminating an area in a radio zone, where said mobile terminal is located, by the latest measuring result of the intensity of reception field strength of the radio signal of said radio base station;
determining a step value to be used for changing a transmission power of said mobile terminal depending on the discriminated area in said radio zone;
comparing with the latest measuring result and past measuring results, being stored, of the intensity of reception field strength of the radio signal of said radio base station, and adding a fixed step value to the determined step value to be used for changing the transmission power of said mobile terminal when an intensity distribution of the comparing result exceeds a fixed threshold value;
detecting contents of said instruction provided by said radio base station control apparatus;
counting up a number of sequentially same indications, and adding a fixed step value to the determined step value to be used for changing transmission power of said mobile terminal when the counted number reaches a fixed threshold value;
increasing the transmission power by the step value having been determined, as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal, and as the result of counting up the number of sequentially same indications when the detected contents of said instruction indicate a power increase; and
decreasing the transmission power by the step value having been determined, as the result of comparison of the latest measuring result and past measuring results of the intensity of reception field strength of the radio signal, and as the result of counting up the number of sequentially same indications when the detected contents of said instruction indicate a power decrease.

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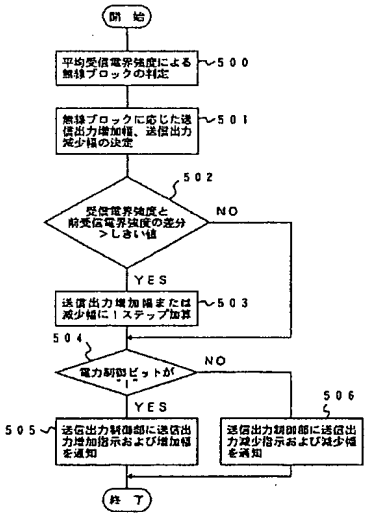
(54)【発明の名称】　移動無線端末の送信電力制御方式

(57)【要約】
【課題】　移動無線端末の送信電力を最適値に設定するまでに要する時間を短縮する。
【解決手段】　無線基地局制御装置は移動無線端末の電波を受信して出力の増減を指示する。そのとき、移動無線端末では無線基地局から受信している電波の受信電界強度の予め定められた閾値との比較、過去データによる増減傾向等の統計的判断及び無線基地局制御装置からの増減指示の傾向判断により、出力電力を最適値に設定するために要する送信出力変更値のステップを可変にして送信出力制御装置に指示する。



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【特許請求の範囲】

【請求項1】　複数の移動無線端末と少なくとも一つの無線基地局と無線基地局制御装置から構成され、前記無線基地局制御装置が前記移動無線端末から受信する電波の受信電界強度を判定し、当該移動無線端末の送信電力の出力値の増減を指示する移動無線端末の送信電力制御方式において、

前記移動無線端末は、

指示された幅で送信電力の増減を制御する送信出力制御手段と、

前記無線基地局から受信する通信中の電波の受信電界強度に応じて送信電力の増減幅を設定する出力増減幅設定手段とを備え、

前記無線基地局制御装置から送信電力の増加あるいは減少の指示を受けると、前記出力増減幅設定手段で設定した増加幅あるいは減少幅を前記送信出力制御手段に指示することを特徴とする移動無線端末の送信電力制御方式。

【請求項2】　前記移動無線端末は、

無線基地局から受信した電波の受信電界強度を複数記憶しておく受信電界強度記憶手段と、

無線基地局から受信する通信中の電波の受信電界強度と前記受信電界強度記憶手段に記憶されている過去に受信した受信電界強度とを比較してその変化度を算出し、当該変化度に応じて前記出力増減幅設定手段が設定した送信電力の増減幅を変更設定する出力増減幅変更設定手段とを更に備え、

前記無線基地局制御装置から送信電力の増加あるいは減少の指示を受けると、前記出力増減幅変更設定手段で設定した増加幅あるいは減少幅を前記送信出力制御手段に指示することを特徴とする請求項1に記載の移動無線端末の送信電力制御方式。

【請求項3】　前記出力増減幅設定手段は、前記無線基地局から受信する通信中の電波の受信電界強度と前記受信電界強度記憶手段に記憶されている過去に受信した受信電界強度との平均値にもとづいて送信電力の増減幅を設定することを特徴とする請求項1または請求項2に記載の移動無線端末の送信電力制御方式。

【請求項4】　前記移動無線端末は、前記無線基地局制御装置から受信する送信電力の増加指示あるいは減少指示を複数記憶する増減指示記憶手段を更に備え、

前記無線基地局制御装置から受けた送信電力の増加指示あるいは減少指示が予め定められた連続回数であることを判定すると、前記出力増減幅設定手段で設定した増加幅あるいは減少幅を変更設定して前記送信出力制御手段に指示することを特徴とする請求項1に記載の移動無線端末の送信電力制御方式。

【請求項5】　前記移動無線端末は、前記無線基地局制御装置から受信する送信電力の増加指示あるいは減少指示を複数記憶する増減指示記憶手段を更に備え、

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前記無線基地局制御装置から受けた送信電力の増加指示あるいは減少指示が予め定められた連続回数であることを判定すると、前記出力増減幅変更設定手段で設定した増加幅あるいは減少幅を更に変更設定して前記送信出力制御手段に指示することを特徴とする請求項2に記載の移動無線端末の送信電力制御方式。

【請求項6】　前記移動無線端末において、

前記出力増減幅設定手段が設定する送信電力の第1の増減幅の値と、前記出力増減幅変更設定手段が変更設定する第2の増減幅の値と、前記無線基地局制御装置から受けた送信電力の増加指示あるいは減少指示が予め定められた連続回数であることを判定したとき前記送信出力制御手段に変更設定して指示する第3の増減幅の値と、前記判定の基準となる連続受信回数の値は、前記無線基地局制御装置から指示されることを特徴とする請求項4または請求項5に記載の移動無線端末の送信電力制御方式。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、移動体通信システムにおける移動無線端末の送信電力制御方式に関し、特に通信中の移動無線端末からの無線品質を無線基地局において測定し、その無線品質に応じて無線基地局制御装置が移動無線端末に対して送信出力の増減指示を行う送信電力制御方式に関する。

【0002】

【従来の技術】移動体通信システムは、一般的に複数の無線エリアを構成する複数の無線基地局と、その複数の無線基地局を統括制御して、固定通信網とインタフェースする移動体通信交換局に接続する無線基地局制御装置とで構成される。このような移動体通信システムにおける従来の移動無線端末の送信電力制御の一例を図8のフローチャートに示す。無線基地局制御装置は無線基地局で測定した移動無線端末の無線品質に応じて、無線基地局を介した下りの信号チャネルを用いて電力制御情報を伝達する。同図に示すように、電力制御ビットにより送信電力の増加または減少を指示する。同ビット＝1の場合は出力の増加を指示し、同ビット＝0の場合は出力の減少を指示する。各指示に応じて、移動無線端末では予め決められた送信電力の変化幅で1ステップ分の増減を行う。

【0003】このような制御方法以外にも、移動無線端末が受信する無線基地局からの電波の受信電界強度にもとづいて、移動無線端末が自律的に送信電力を制御する方法もある（特開昭61－43026号公報参照）。また、無線基地局制御装置から送信電力の変更を指示される方法においても、増加または減少の変更ステップ数を指示するものもある。

【0004】

【発明が解決しようとする課題】このような従来の移動

無線端末の出力電力制御方式において、移動無線端末が自律的に送信電力を制御する場合は、受信電界強度にもとづき制御しているのでフェージングなど一時的な受信電界強度の落ち込みにも対応することとなり、必ずしも最適な送信電力を出力しているとはいえない。また、無線基地局制御装置からの指示により送信電力を制御する場合においても、送信電力出力値が最適値に達するまでに時間がかかり、電源を入れて立ちあげたばかりの移動無線端末はまず最大出力で送信するため、最適出力値に達するまでの間、電力が無駄に消費されるという問題があった。また、このように大電力で送信すると他の移動無線端末に干渉を与えてしまうという問題があるので、短時間に速やかに送信電力を最適値に制御する必要があった。

【０００５】

【課題を解決するための手段】本発明の移動無線端末の送信電力制御方式は、以上に述べたような問題を解決し、移動無線端末の送信電力出力が最適な値に達するまでにかかる時間を短縮することにより余分な電力の消費を押さえ、他の移動無線端末に与える干渉を極力軽減する送信電力制御方式を提供することを目的とする。

【０００６】本発明の移動無線端末の送信電力制御方式は、複数の移動無線端末と少なくとも一つの無線基地局と無線基地局制御装置から構成され、無線基地局制御装置が移動無線端末から受信する電波の受信電界強度を判定し、当該移動無線端末の送信電力の出力値の増減を指示する移動無線端末の送信電力制御方式において移動無線端末は以下の構成を備えることを特徴とする。

【０００７】（１）指示された幅で送信電力の増減を制御する送信出力制御手段と、（２）無線基地局から受信する通信中の電波の受信電界強度に応じて送信電力の増減幅を設定する出力増減幅設定手段とを備え、（３）無線基地局制御装置から送信電力の増加あるいは減少の指示を受けると、出力増減幅設定手段で設定した増加幅あるいは減少幅を送信出力制御手段に指示する。

【０００８】また、移動無線端末は、更に以下の構成も備えている。

【０００９】（１）無線基地局から受信した電波の受信電界強度を複数記憶しておく受信電界強度記憶手段と、（２）無線基地局から受信する通信中の電波の受信電界強度と受信電界強度記憶手段に記憶されている過去に受信した受信電界強度とを比較してその変化度を算出し、当該変化度に応じて前記の出力増減幅設定手段が設定した送信電力の増減幅を変更設定する出力増減幅変更設定手段とを更に備え、（３）無線基地局制御装置から送信電力の増加あるいは減少の指示を受けると、前記の出力増減幅変更設定手段で設定した増加幅あるいは減少幅を前記の送信出力制御手段に指示する。

【００１０】また、前記の出力増減幅設定手段は、無線基地局から受信する通信中の電波の受信電界強度と前記

の受信電界強度記憶手段に記憶されている過去に受信した受信電界強度との平均値にもとづいて送信電力の増減幅を設定することを特徴とする。

【００１１】更に移動無線端末は、無線基地局制御装置から受信する送信電力の増加指示あるいは減少指示を複数記憶する増減指示記憶手段を更に備え、無線基地局制御装置から受けた送信電力の増加指示あるいは減少指示が予め定められた連続回数であることを判定すると、前記の出力増減幅設定手段で設定した増加幅あるいは減少幅を変更設定し、あるいは前記の出力増減幅変更設定手段で設定した増加幅あるいは減少幅を更に変更設定して送信出力制御手段に指示する。

【００１２】前記の移動無線端末において、出力増減幅設定手段が設定する送信電力の第１の増減幅の値と、出力増減幅変更設定手段が変更設定する第２の増減幅の値と、無線基地局制御装置から受けた送信電力の増加指示あるいは減少指示が予め定められた連続回数であることを判定したとき送信出力制御手段に変更設定して指示する第３の増減幅の値と、前記判定の基準となる連続受信回数の値は、無線基地局制御装置から指示されることを特徴とする。

【００１３】

【発明の実施の形態】本発明の構成について図面を参照して説明する。

【００１４】図１は本発明の移動無線端末の送信電力制御方式における移動無線端末、無線基地局、無線基地局制御装置の構成を示すシステム構成図である。移動無線端末１００は、無線基地局１０１と無線エリアＬ１の中で周波数ｆ１，ｆ１′で無線送受信を行う機能を持つ。また、受信周波数ｆ１に関して受信電界強度を測定する機能をもち、その測定値を記憶しておく機能を持つ。無線基地局１０１，１０２は、無線基地局制御装置１０３に接続され、構成する無線エリアＬ１，Ｌ２内の移動無線端末と無線基地局制御装置１０３との間のデータの送受信を、割り当てられた無線周波数を使用して中継する機能を持つ。無線基地局１０１は、受信周波数ｆ１′に関し、無線品質を監視するための受信電界強度を測定し、無線基地局制御装置１０３へ通知する機能を持つ。無線基地局制御装置１０３は、自装置に接続されている無線基地局１０１，１０２と無線接続されている移動無線端末とデータの送受信を行う。また通信中の移動無線端末１００の受信電界強度を監視する機能を持ち、その値に応じて移動無線端末１００に対し、送信電力の出力を増加または減少させる指示を送る機能を持つ。

【００１５】図２は、本発明の第１の実施の形態における移動無線端末のブロック構成図である。

【００１６】無線送受信部２０１は無線基地局との無線インタフェースを行い、受信部２０２及び復調部２０３は無線受信信号のデジタル信号への変換を行う。ＣＯＤＥＣ部２０４は、音声信号の符号化、復号化を行い、送

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信部２０５及び変調部２０６はデジタル信号の無線送信信号への変換を行う。受信電界強度測定部２０７は無線送受信部において受信した信号の受信電界強度の測定を行い、送信出力制御部２０８は、制御部２０９から指示に従い、送信電力の調整を行う。制御部２０９は、無線区間を含む電話回線の回線接続、各ブロックの制御等を行う。また、制御部２０９は、受信電界強度により、送信出力増加幅および減少幅を決定する機能、また測定した受信電界強度を記憶する機能をもち、送信出力制御部２０８に送信出力の増加または減少指示を行う機能を持つ。

【００１７】図３は、無線基地局が移動無線端末に対して送信する、下り回線のバースト信号の構成図である。無線基地局制御装置はバースト信号内に設定されている電力制御ビットにより移動無線端末の送信出力制御を行うものであり、電力制御ビット＝“１”は送信出力増加指示、電力制御ビット＝“０”は送信出力減少指示である。

【００１８】図４は、無線エリアブロックの一例を示す概念図である。同図において、ブロック４０１は、受信電界強度の高いエリア、つまり無線エリアの中心付近であり、ブロック４０２は、受信電界強度の低いエリア、つまり無線エリアの境界付近であり、ブロック４０３は、ブロック４０１とブロック４０２の中間のブロックである。各無線ブロックは、その無線エリアに存在する移動無線端末が測定する受信電界強度により判定される。そのため移動無線端末は、ブロック４０１とブロック４０３を判定するために無線ブロック判定しきい値１を、ブロック４０２とブロック４０３を判定するために無線ブロック判定しきい値２を有する。

【００１９】次に、本発明の動作について図５を参照して説明する。図５は、本発明による移動無線端末の送信電力制御の動作を説明するフローチャートである。

【００２０】図２の移動無線端末において、制御部２０９には、図４で説明した無線ブロックを判定するため、予め、無線ブロック判定しきい値１、無線ブロック判定しきい値２を設定してある。また、受信電界強度を適当な回数分記憶し、その平均値を算出する機能、および受信電界強度の変化度をチェックするための受信電界強度変分しきい値を持つ。

【００２１】また、送信出力制御部２０８は、送信出力制御を３０ｄＢｍの範囲を１ステップあたり０．５ｄＢｍで制御可能であるものとする。

【００２２】移動無線端末は、無線基地局１０１より受信した周波数ｆ１の受信電界強度を受信電界強度測定部２０７で測定し、その結果を制御部２０９に通知する。制御部２０９は、通知された受信電界強度と前もって決められた適当な回数分の受信電界強度より、平均受信電界強度を算出し、自端末が図４のように構成されたどの無線ブロックにいるかを判定するため、平均受信電界強

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度と、無線ブロック判定しきい値１および無線ブロック判定しきい値２を比較する。平均受信電界強度が、無線ブロック判定しきい値１より大きい場合はブロック４０１、無線ブロック判定しきい値２より小さい場合はブロック４０２、無線ブロック判定しきい値１と無線ブロック判定しきい値２の間にある場合はブロック４０３にいると判定する（ステップ５００）。そして、その判定したブロックに応じた送信出力増加幅および送信出力減少幅を決定する（ステップ５０１）。（たとえば、ブロック４０１の場合は、増加幅および減少幅の単位をそれぞれ３ステップ、１ステップに、ブロック４０２の場合はそれぞれ１ステップ、３ステップに、ブロック４０３の場合はそれぞれ１ステップ、１ステップとする。）次に、測定した受信電界強度と、前回測定し、記憶してある前受信電界強度を比較し（ステップ５０２）、その差分が受信電界強度変分しきい値より大きい場合、受信電界強度が増加している場合は、送信出力増加幅に１ステップ加算し、受信電界強度が減少している場合は、送信出力減少幅に１ステップ加算する（ステップ５０３）。制御部２０９は、送信出力増加幅、送信出力減少幅の決定後、無線基地局１０１より受信したバースト信号内に設定された電力制御ビットを取得し、そこに設定されている値をチェックする（ステップ５０４）。“１”が設定されている場合は、送信出力制御部２０８に対し、送信出力の増加を指示し、送信出力増加幅を通知する（ステップ５０５）。“０”が設定されている場合は、送信出力制御部２０８に対し、送信出力の減少を指示し、送信出力減少幅を通知する（ステップ５０６）。送信出力制御部２０８は、制御部２０９より受けた送信出力の指示および送信出力増加幅または送信出力減少幅に従い、送信出力を増加または減少させる。

【００２３】本発明において、ステップ５０１、ステップ５０３で用いている送信出力制御のためのステップ数は適当な値を使用するものとする。また、ステップ５０２，５０３で用いる前受信電界強度の代わりに適当な回数の平均受信電界強度を用いてもよく、またステップ５０３で受信電界強度の変化度による送信出力減少幅の加算は行わなくともよい。

【００２４】続いて本発明の移動無線端末の送信電力制御方式の第２の実施の形態について図６を参照して説明する。図６は、本発明の第２の実施の形態の移動無線端末の送信電力制御の動作を説明するフローチャートである。移動無線端末において、制御部２０９には、第１の実施の形態に記載した機能に加え、予め各バースト信号内に設定される電力制御ビットの設定値を適当な回数分記憶しておく機能を有する。

【００２５】制御部２０９は、図５のフローチャートと同様に送信出力増加幅および送信出力減少幅の決定後（ステップ６００～６０３）、受信バースト信号内の電力制御ビットを取得し、そこに設定されている値をチェ

ックする（ステップ６０４）。“１”が設定されている場合、予め記憶してある適当な回数の電力制御ビットをチェックし、“１”を一定回数、例えば１０回連続受信している場合（ステップ６０５）は、送信出力増加幅に２ステップ加算する（ステップ６０６）。送信出力増加幅の決定後、送信出力制御部２０８に送信出力の増加を指示し、送信出力増加幅を通知する（ステップ６０７）。また、ステップ６０４で“０”が設定してある場合、予め記憶してある適当な回数の電力制御ビットをチェックし、“０”を１０回連続して受信している場合（ステップ６０８）は、送信出力減少幅に２ステップ加算する（ステップ６０９）。送信出力減少幅を決定後、送信出力制御部２０８に送信出力の減少を指示し、送信出力減少幅を通知する。送信出力制御部２０８は、制御部２０９より受けた送信出力の指示および送信出力増加幅または送信出力減少幅に従い、送信出力を増加または減少させる。

【００２６】このような移動無線端末の送信電力制御方式について、具体的な実施例を説明する。移動無線端末１００が電源投入時、無線エリアの中心付近にいる場合について説明する。

【００２７】移動無線端末１００は、送信出力を３０ｄＢｍの範囲で１ステップあたり０．５ｄＢｍで制御可能であるものとし、また電源投入後、無線エリアの中心付近から移動しないものとする。

【００２８】移動無線端末１００は、電源投入時、送信出力を最大にして無線基地局と通信を行う。また、無線エリアの中心付近における最適送信出力は、送信出力が最小の場合である。つまり、この場合移動無線端末１００は、送信出力を最大から最小に変更させる必要がある。またこの間、無線基地局から受信するバースト信号内に設定される電力制御ビットは、移動無線端末１００の送信出力が、最適送信出力、すなわち最小送信出力になるまで、常に電力制御ビット＝“０”に設定されている。また、移動無線端末１００は、無線エリアの中心付近より移動しないため、受信電界強度の変分はないものとする。

【００２９】移動無線端末１００は、電源投入時、測定した受信電界強度より、自端末がブロック４０１にいると判断し、送信出力減少幅を３ステップに決定する（ステップ６００，６０１）。受信電界強度の変分はないため、送信出力減少幅の加算は行わない（ステップ６０４）。移動無線端末１００は、電力制御ビット＝“０”の連続受信回数が一定回数（１０回）に達していないため、送信出力減少幅を３ステップとして送信出力を減少させる（ステップ６０８）。移動無線端末１００は、受信電界強度の変分がないため、受信バースト信号数が１０に達するまで、送信出力減少幅を３ステップとして、送信出力を減少させる。受信バースト信号数が１０に達した場合、送信出力減少幅に２ステップ加算し（ステップ６０８，６０９）、送信出力減少幅を５ステップとして、送信出力を減少する。

【００３０】この実施例において、移動無線端末１００の送信出力が最大から最小まで変化するまで、つまり３０ｄＢｍ変化するまでに受信するバースト信号数は、最初に１５ｄＢｍ減少するまでに１０バースト、残りの１５ｄＢｍ減少するまでに６バースト、あわせて１６バーストである。通常の移動無線端末が送信出力を１ステップづつ減少させるものとすると３０ｄＢｍ変化するまで６０バースト受信する必要があり、それと比較すると最適送信出力になるまでの時間は、単純比較で３．７５倍の効率化となる。

【００３１】更に、本発明の移動無線端末の送信電力制御方式の第３の実施の形態について説明する。図７は、無線基地局制御装置が移動無線端末に対し送信出力制御に使用する各設定値を通知する際の通信シーケンス図である。移動無線端末１００は、予め送信出力制御のための初期設定値として、これまでの実施の形態で説明した、記憶する受信電界強度数、無線ブロック判定しきい値１、無線ブロック判定しきい値２、各無線ブロック毎の送信出力増加幅および送信出力減少幅、受信電界強度変分しきい値、記憶する電力制御ビットの回数およびその連続受信数を制御部２０９に記憶しておき、その設定値に従って送信出力制御を行う。

【００３２】無線基地局制御装置１０３は、自装置と接続する無線基地局１０１，１０２を介して、通信中の移動無線端末１００に対し、上記の各設定値を報知情報６０１として通知する。移動無線端末１００が報知情報６０１を受信した時、制御部２０９は、その中に設定してある送信出力制御に関する各設定値を記憶し、以降その設定値に従い、送信出力制御を行う。無線基地局制御装置１０３は、変更のない限り同じ設定値を報知情報として通知し続ける。

【００３３】本発明において、報知情報６０１で送信出力制御用として移動無線端末１００に通知する各設定値は、ここで述べたものに限定するものでなく、そのうちの必要なものを通知してもよい。

【００３４】

【発明の効果】本発明の移動無線端末の送信電力制御方式は、移動無線端末の送信電力を最適送信出力にするために必要とする時間を短縮することができる。その理由は、自端末が受信する電波の受信電界強度および受信電界強度の変化度に応じて、送信出力の増減幅を変更するためである。

【００３５】また、最適送信出力にするまでの時間が短縮できるということは、送信電力が最適送信出力より大きい場合は、余分な電力を消費する時間が短くなり、他の移動無線端末に与える干渉を軽減する効果があり、また送信電力が最適送信出力よりも小さい場合は、自端末の通信状態を早く良好な状態に保つことができるという

効果がある。

【図面の簡単な説明】

【図１】本発明の移動無線端末の送信電力制御方式が適用される移動体通信システムの概要を示すシステム構成図である。

【図２】本発明の移動無線端末の送信電力制御方式が適用される移動無線端末の構成を示すブロック図である。

【図３】無線基地局制御装置から移動無線端末に送出されるバースト信号の構成の一例を示す信号構成図である。

【図４】無線基地局が構成する無線ゾーンの形態の概念を示す模式図である。

【図５】本発明の第１の実施の形態の動作を説明するフローチャートである。

【図６】本発明の第２の実施の形態の動作を説明するフローチャートである。

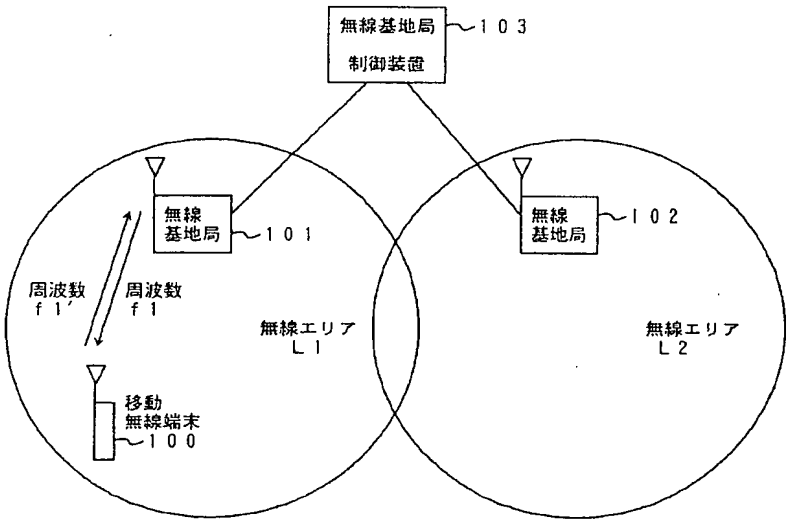
【図７】本発明の第３の実施の形態の動作を説明する信号シーケンス図である。

【図８】従来の技術による移動無線端末の送信電力制御方式の動作のフローチャートである。

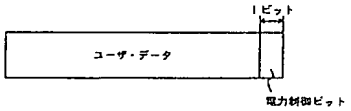
【符号の説明】

１００　移動無線端末
１０１，１０２　無線基地局
１０３　無線基地局制御装置
２０１　無線送受信部
２０２　受信部
２０３　復調部
２０４　ＣＯＤＥＣ部
２０５　送信部
２０６　変調部
２０７　受信電界強度測定部
２０８　送信出力制御部
２０９　制御部
４０１～４０３　無線ブロック
ｆ１，ｆ１′　無線周波数
Ｌ１，Ｌ２　無線エリア

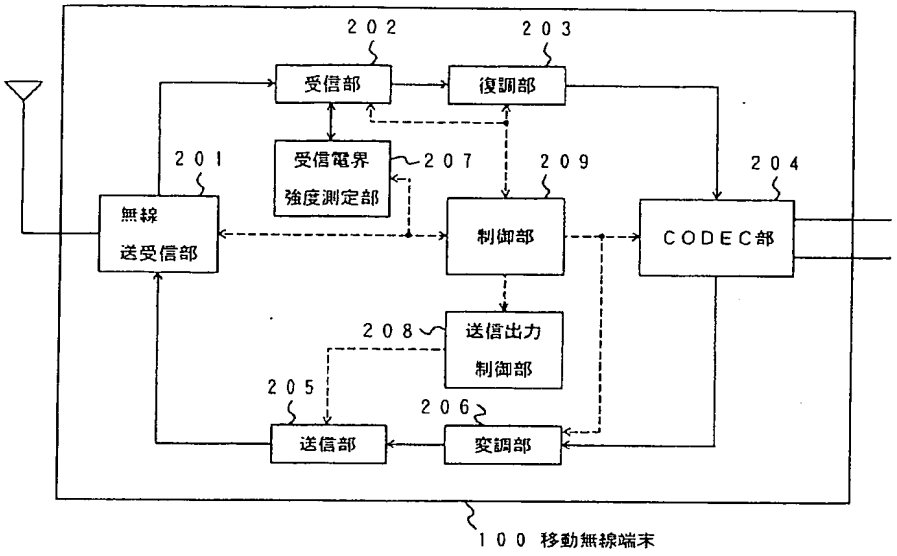
【図１】



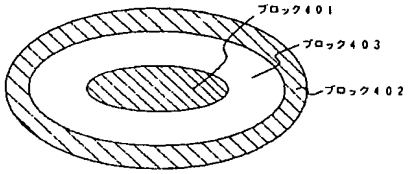
【図３】



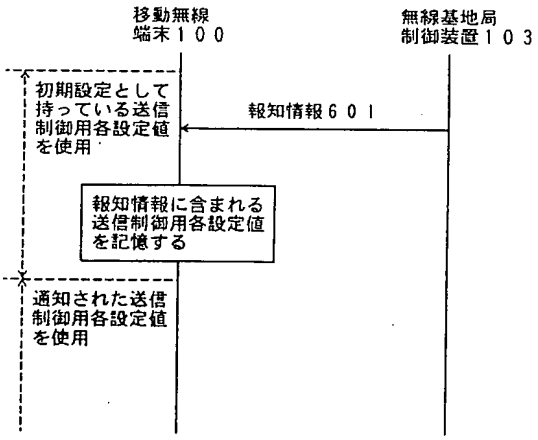
【図2】



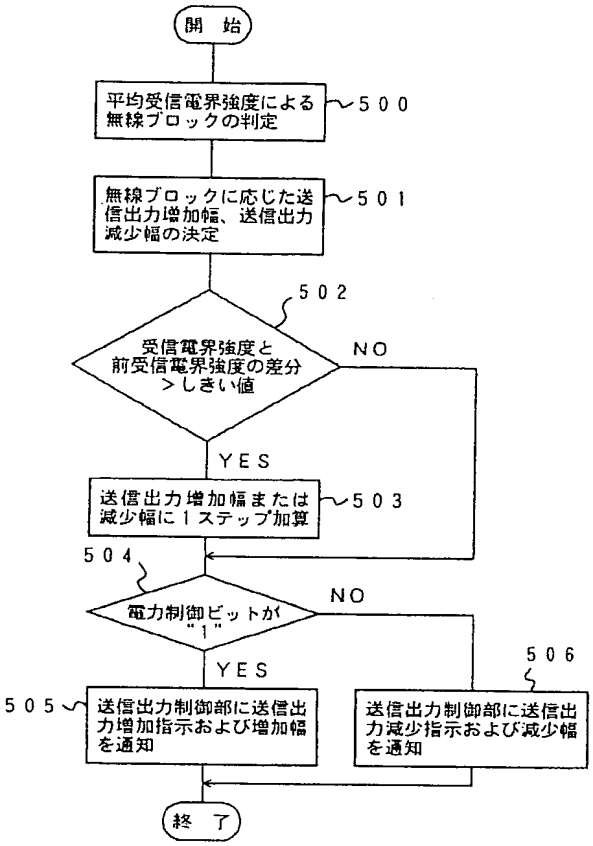
【図4】



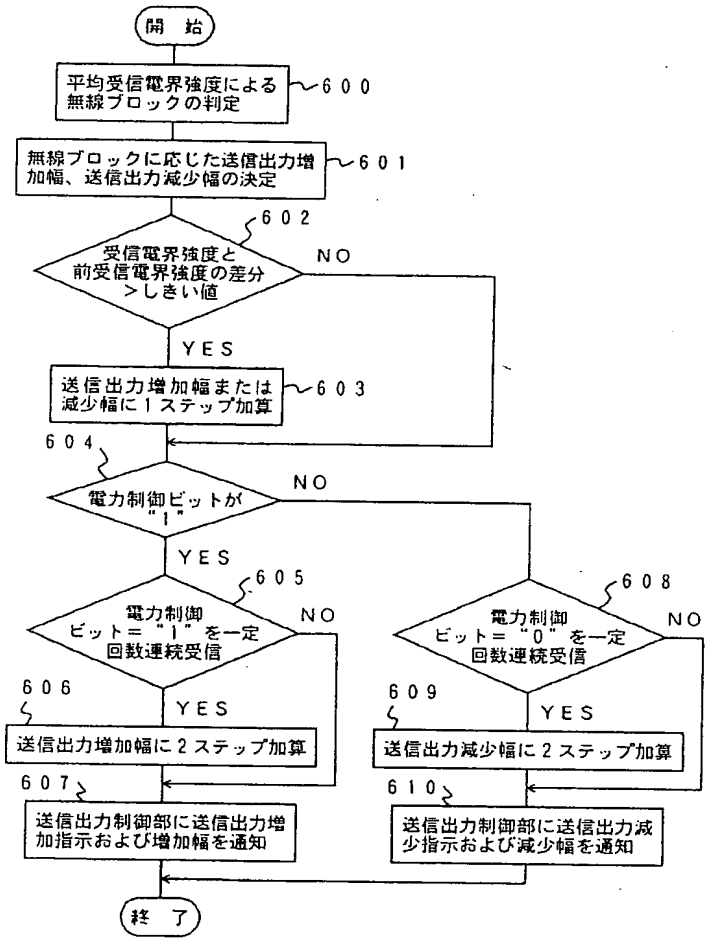
【図7】



【図5】



【図6】



【図8】